Simulation in der Logistik

ehem.: Simulation in Logistics I

Installation and Introduction of Dosimis 3

Lecturer: Prof. Dr.-Ing. Bernd Noche
Introduction of Dosimis

Object-oriented Simulation Software

Powerful Data Analysis Diagram

Simulation and Animation

Development 26 years

New Version 6.2

Start and End Station
Different Conveyors
Building Blocks System
Control and Analysis System

Start and End Station
SEN
QUE

Different Conveyors
SST
FST
FST

Building Blocks System
AST
PAL
MON
DEM
MAS
MFA
ASL
ESL

Control and Analysis System
BLK
BEL
ENT
PNZ
PNE
PBS

ATO
ASW
DZM
MOR

A-Z
PLY

Start and End Station

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Development 26 years
The Application of Dosimis

Data Preparation

Simulation

Optimization

Simulation time = 70 days
Run Time = 15 days
Quantity of Sips = 12 (2 x 800 TEU, 6 x 500 TEU, 4 x 350 TEU)
Speed down river [m/s] = 7.0
Speed Upstream [m/s] = 4.0
Speed in Canal [m/s] = 6.0
Mooring Time in Port [min] = 70
Disposition Time in Port [min] = 30
Load / Unload / TEU [min] = 3
Transshipment Point … …

Analysis of Row Data

Simulation with Dosimis

Optimization of Results
Application for Production System

Blueprint, Design Paper, Drawing Paper and CAD Paper

Dosimis Simulation
Application for Warehouse System

Accumulated Conveyor or Street ...

Processing Machine

Lift for Entrance

Warehouse 1 and 2

Lift for Exit

Nr. of Parkplace for Vehicle

DT for Sensors

DT for Products Entrance

DT for Products Exit
Application for Transportation

Decision-Making Strategy

<table>
<thead>
<tr>
<th>St.</th>
<th>Port</th>
<th>Quay Cranes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amsterdam</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Rotterdam</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Antwerpen</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Emmerich</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Duisburg</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Bonn</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Koblenz</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Frankfurt</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Aschaffenburg</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Ludwigshafen</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Gemersheim</td>
<td>1</td>
</tr>
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<td>12</td>
<td>Woerth</td>
<td>3</td>
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<td>13</td>
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<td>14</td>
<td>Strasbourg</td>
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<tr>
<td>15</td>
<td>Ottmarsheim</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Weil</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Basel</td>
<td>1</td>
</tr>
</tbody>
</table>
List of Contents

• Introduction in DOSIMIS-3

• Special elements of DOSIMIS-3

• Introduction in simulation runs and statistics
DOSIMIS-3

- DOSIMIS-3 is one of the fastest discrete simulation tools.
- DOSIMIS-3 offers a rich component library to the user for the ranges production and conveying engineering and detailed results on push of a button.
- The users can define the parameter of elements quickly and easily by dialog boxes. Writing of source code to define the behavior is not necessary.
- In order to implement complex control algorithms, decision tables are available to the user. With these control elements rules can be defined guided by menus.
- Practice orientated development of DOSIMIS-3.

• Areas of application
  - Simulation of material-, process- and personal flow in manufacturing systems, storage systems, transportation systems.
The integrated layer concept

- Supply-Chain
  - Concern strategies

- Simulation of a planned production process
  - Delivery time
  - Throughput time

- The questions determine the grade of abstraction of the model

- Productions areas/Assembly lines
  - Which cycle times?
  - Where are the bottle necks?

- Material supply

- Receipt/Issue of goods, storage
  - Floor space requirements

- Worker
  - Capacity planning with
  - Multi machine operation
  - Shifts
Examples for mapping of components

• **Storage systems**
  – Palette system
  – Carousel storage

• **Transport vehicles**
  – Fork lifts
  – Rack feeder
  – Automatic Guided vehicles (AGV)

• **Conveyor technique**
  – Roller conveyor
  – Chain conveyor
  – Power and Free
Structure Dosimis-3 – model layer

- Operating time
- Shift-, pause model, technical availability
- Failure
- Working plans, decision table, programming interface
- Transport system, working areas
- Local strategies
- Modules
- Right of way strategy, distribution strategy
- Programm
- Transportscheduling, worker scheduling
- Transport-, Production order
- Custom order, production order
- Components
- Kinematics (length, speed, lift time, ...), process times (working, assembling, picking, packing, ...)
- Rechnergestützte Modellierung
Modules

• For components of a material flow system DOSIMIS-3 offers several predefined modules.

• The internal logic of a module type is predefined, not depending on the system.

• The modules will be adjusted with their geometry and strategy parameter to the concrete system.
Junctions

The **direction** of the material flow is defined by the junctions between the modules.

A **junction** connects an exit of a module with an entrance of a module.
Objects

• Objects represent all elements, which pass through the defined material flow system. The system load is represented by the objects. They pass through the modules.

• Example:
  – Work pieces
  – Tools
  – Work piece holder
  – Transport equipment
  – Means of transport

• The system load describes the necessary instructions which are dispatched into the model from the start of the simulation run (e.g. material, information, work content). Objects have a type number, which can be evaluated and changed by certain modules.
Object flow

- The flow of the objects through the system is controlled by the modules parameter.
- An object can enter a module if
  - the occupation of the module is less than the capacity of the module
  AND
  - the input junction is not occupied (the last object is still entering).
DOSIMIS-3
Structure of Dosimis-3

Dosimis-3

Editor

Modeling
- Modules
- Strategies
- Failures, pauses
- Working areas
- Transport systems,
- Working plans
- Decision tables
- Excel interface
- Programming interface

Animation
- Standard-Animation
- Bitmap-Animation

Results
- Statistics
- Diagrams

Graphics
- Graphical comments
- Bitmaps

Offline Simulation
- Parameter
- Excel-interface
- COM-interface
- Optimization

Online Simulation
- Parameter
- Debug-function
DOSIMIS-3 Editor
Usage of DOSIMIS-3

Common:

- All usable functions and short-cuts of the windows programs are also available in DOSIMIS-3.
  - Example:
    - Selection with the left mouse button
    - Right mouse button opens the context menu
    - Opening of the parameter dialog by double click (left mouse button)
  - Short-Cuts are assigned to the known functions (a list of short keys can be found in the appendix)
Usage of DOSIMIS-3

• Modeling
  – Inserting a module
    • Open the module palette (F2 or menu: View • Modules Palette)
    • Selection of the desired module in the palette with the left mouse button
    • The module is “adhered” at the mouse pointer
    • Place the module by clicking the left mouse button
      – Special case: conveyors are defined by several points (left mouse button for defining way points; right mouse button for end)
  – Definition of the material flow (connecting the modules)
    • Activate the connecting mode (F9 or menu: Model • Linking active)
    • Selection of the start module and the destination module with the left mouse button.
    • With the left mouse button further way points can be defined.
    • With the right mouse button the linking is terminated.
Standard parameter

- DOSIMIS-3 offers the possibility
  - To define standard values for object length and conveying speed. These values will be used when new modules are created.
  - To define and change global parameters • **Defaults**
    - Example: Speed and length of transport elements
Defaults

• Opening of the parameter dialog by
  – Menu: Model ‒ defaults
  – In each parameter dialog of the modules this dialog can be reached by the button „Defaults“

• The following constants are available
  – Integer – constants (integer value)
  – Float – constants (real values)
  – Object type – constants (name for numerical objekt types)
  – (Transport system) Destination – constants (name for numerical destination constants)
  – (Worker) Qualification – constants (name for the qualification)
DOSIMIS-3 Modules

- Basic modules
  - Source (SOU)
  - Sink (SIN)
  - Working station (WST)
  - Accumulating Conveyor (ACC)
  - Distributor (DIS)
  - Combining station (COM)
  - Assembly station (ASS)
  - Disassembly station (DAS)
  - Break (BRK)
  - Work area (WRA)

- Further modules
  - Conveyor (CON)
  - Crossing (CRO)
  - Shuttle (SHU)
  - Capacity monitoring (CPM)
Function keys

- **Function keys**
  - **F1:** Open / Close of online-help
  - **F2:** Open / Close of modules palette
  - **Strg + F2:** Open / Close of control palette
  - **Shift + F2:** Open / Close of graphic toolbar
  - **F3:** Open of search dialog
  - **F5:** Redraw workarea
  - **F7:** Start of simulation (offline)
  - **Strg + F7:** Start / End of online simulation
  - **Alt + F7:** Open simulation parameter
  - **F9:** Connecting mode
  - **F11:** Start of animation
  - **Shift + F11:** Open / Close of animation toolbar
  - **Alt + F11:** Open animation parameter
## Short-Cuts

<table>
<thead>
<tr>
<th>Short-Cuts</th>
<th>Ctrl + A:</th>
<th>Select all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl + C:</td>
<td>Copy selected elements to the clipboard</td>
<td></td>
</tr>
<tr>
<td>Ctrl + X:</td>
<td>Copy selected elements to the clipboard and erase them from the model.</td>
<td></td>
</tr>
<tr>
<td>Ctrl + V:</td>
<td>Paste from clipboard.</td>
<td></td>
</tr>
<tr>
<td>Ctrl + D:</td>
<td>Duplicate selection</td>
<td></td>
</tr>
<tr>
<td>Ctrl + I:</td>
<td>Insert another model</td>
<td></td>
</tr>
<tr>
<td>Ctrl + M:</td>
<td>Move</td>
<td></td>
</tr>
<tr>
<td>Ctrl + R:</td>
<td>Rotate (left)</td>
<td></td>
</tr>
<tr>
<td>Ctrl + W:</td>
<td>Mirror</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short-Cuts</th>
<th>Ctrl + F:</th>
<th>Open search dialog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl + P:</td>
<td>Open parameter dialog</td>
<td></td>
</tr>
<tr>
<td>Ctrl + S:</td>
<td>Save the model</td>
<td></td>
</tr>
<tr>
<td>Shift + F:</td>
<td>Zoom-Window</td>
<td></td>
</tr>
<tr>
<td>Shift + M:</td>
<td>Show complete model</td>
<td></td>
</tr>
<tr>
<td>Shift + B:</td>
<td>Export actual view in bitmap format</td>
<td></td>
</tr>
</tbody>
</table>
The complete information about the model is saved in three files:

- `[Modelname].mfs` - *material flow file*
  - Contains all information of elements and strategies.
- `[Modelname].dar` - *representation file*
  - Contains the coordinates of the elements on the desktop
- `[Modelname].dxg` - *graphic file*
  - Contains all information about the graphical comments

Further files are created after processing the model and during or after the execution of the simulation.
Modules – Source (SOU)

Interface module

The source generates objects and delivers them to the successor.

e.g. receipt of goods
Modules - Sink (SIN)

Function

Interface module
The objects leave the system.
e.g. issue of goods

Flow chart

Object enters (entering time = 0)

leaving time

Waiting for leaving time

The sink is free
Modules – Accumulating Conveyor (ACC)

**Function**

FIFO – principle

Transport and storing
e.g. roller conveyor, chute

**Flow chart**

Object is entering

length, speed, capacity

Travel time

Object is ready to leave

Is entering of the successor possible?

yes

Delivering to the successor

no

waiting

Transport and storing and storing

e.g. roller conveyor, chute
Demo model 1 – Step 1
Demo model - Parameter

• Defaults
  – Object length: 1.2 m
  – Speed: 0.3 m/s
  – Product:
    • Article A: Object type 10 (Type_A)
    • Article B: Object type 20 (Type_B)
    • Stack A: Object type 110 (Stack_A)
    • Stack B: Object type 120 (Stack_B)
    • Emptpal: Object type 99
Demo model 1 – Parameter 1

• Source „SOU_Demo_1“:
  – Object generation: random sequence 2 products (Article A & B), 1:1
  – Distribution: normal distributed
    • Mean value: 60 sec
    • Deviation: 5 sec

• Accumulating conveyor „ACC_Demo_1“:
  – Capacity: 5
  – Segment length: 1.2 m
  – Speed: 0.3 m/s

• Sink „SIN_Demo_1“:
  – Leaving time:
    • Kind of distribution: exponential distributed
    • Mean value: 60 sec
Simulation run/Experiment

Before the simulation run you have to check the model for faults. If any element has a wrong parameter or any information is still missing (e.g. length or speed of a conveyor) it will be impossible to start a run. The module(s) will be drawn green or red after running the consistency check.

To open the simulation parameter dialog you have to press ALT+F7 or select “Simulation” • “Parameter” in the menu bar. In this parameter dialog you have to define:

• simulation time
• pre-run time
• the length of the statistic interval.

Furthermore you are able to select different statistic files, to exclude the work areas, to disable failures and to fix all cycle times.

To start a simulation run press “F7” or select “Simulation” • “Start”. After starting the run, a dialog is opened displaying the state and the simulation time of this simulation run.
Simulation run/Experiment

Selection of worker animation and excluding of worker scheduling

Excluding of failures/maintenance/pauses/working pauses and random processes

Selection of different statistics

Definition of protocol contents

Selection of different statistic files

Simulation time/ pre-run/statistic interval
Format: In minutes or dd:hh:mm

Statistical files

Selection of different statistics
Animation

To visualize the events of a simulation run, the animation can be used. During the animation the types of the objects, that in the modules, are shown. Additionally the state of these objects is marked by different colors:

<table>
<thead>
<tr>
<th>State of the object</th>
<th>animation color</th>
</tr>
</thead>
<tbody>
<tr>
<td>transport</td>
<td>green</td>
</tr>
<tr>
<td>blockage</td>
<td>red</td>
</tr>
<tr>
<td>In process</td>
<td>blue</td>
</tr>
<tr>
<td>setup</td>
<td>light blue</td>
</tr>
<tr>
<td>Waiting for worker</td>
<td>yellow</td>
</tr>
<tr>
<td>Waiting for setup worker</td>
<td>cyan</td>
</tr>
<tr>
<td>Object is leaving the module</td>
<td>red border</td>
</tr>
</tbody>
</table>

Start of animation by:

- F11
- Menu: Animation • Start
- In the dialog „Animation parameter“ by button „Start“
- Button ( ) of the animation toolbar

During the standard animation the movements inside the modules are not shown. A continuous motion will be realized by the continuous animation.
Animations parameter

- Activating continuous animation
- Definition of animation starting point
- Selection of output format of the simulation time
- Definition number of UNDO steps in the animation
- Definition of kind of animation

Animations parameter dialog box:
- Name: ANL_0
- Comment: 
- Standard | Representation | Kind of animation | Bitmap
- Points of animation: Min: 0, Max: 1
- Kind of animation:
  - Event steps
  - Single step (space)
  - Time step (space)
  - Time factor: 50

Key points:
- Activating continuous animation
- Definition of animation starting point
- Selection of output format of the simulation time
- Definition number of UNDO steps in the animation
- Definition of kind of animation
Modules– Workstation (WST)

Function

Processing an object

e.g. machine, I-points, quality control...

Flow chart

Objekt enters the module → Objekt will be transported

Object type in the list of the current work procedure?

see next sheet

List of Work procedures → Switch to next work procedure

Last work procedure?

Object is leaving the module

yes

no

Objects

Object is leaving the module

Objects
Modules – Workstation (WST)

Properties

- There is at least one work procedure to be defined. You have to define a list of object types with the cycle time for each object type.
- If an object type is not defined in this list, the object will only be transported through this station.
- It is possible to use statistical distribution and to add any number of workers for this process.

Flow chart - Detail

Is setup necessary?

- Does the set-up need any workers?
  - Define setup time + setup
- Does the processing need any workers?
  - Define process time + processing
  - Define new object type

Setup matrix

List of process and cycle time

List of new object types after processing

maybe waiting for worker

maybe waiting for worker
Demo model– Step 2
Demo model– Parameter 2

• Workstation „WST_Demo_1“:
  – Article A
    • Process time
      – Distribution: normal distributed
      – Mean value: 60 sec
      – Deviation: 6 sec
  – Article B
    • Process time
      – Distribution: uniformly distributed
      – Lower limit: 50 sec
      – Upper limit: 70 sec
  – Both workstations have a length of 1.2 m and a speed of 0.3 m/s
  – There is no employment of workers and no setup necessary.
Distribute

Distribution of the object flow among any number of exits.

- The capacity of the distributor is one.
- The destination will be defined after the travel time.
Combining

Combining of the object flow among any number of entrances

• The capacity of a combining element is one.

• The right of way strategy will only be evaluated, if more than one object is waiting at the entrances.
Right of way- and distribution strategy

DOSIMIS-3 offers several strategies to divide or merge the material flow. The following strategies are offered by the selection box:

• Right of way strategies
  – FIFO
  – Priority of entrances
  – Priority of object types
  – Maximum relative occupation
  – Maximum absolute occupation
  – Self defined

• Distribution strategies
  – Minimum occupation
  – Maximum free capacity
  – Alternating
  – Priority of exits
  – Percentual
  – Bauschuld
  – Destination with
  – Self defined
Demo model– Step 3
Demo model – Parameter 3

- Duplicate buffer and working station twice
- Distribution element „DIS_DEMO“
  - Distribution strategy
    - Minimum occupation
  or
    - Destination with object type
- Combining element „COM_DEMO“
  - Right of way strategy
    - FIFO